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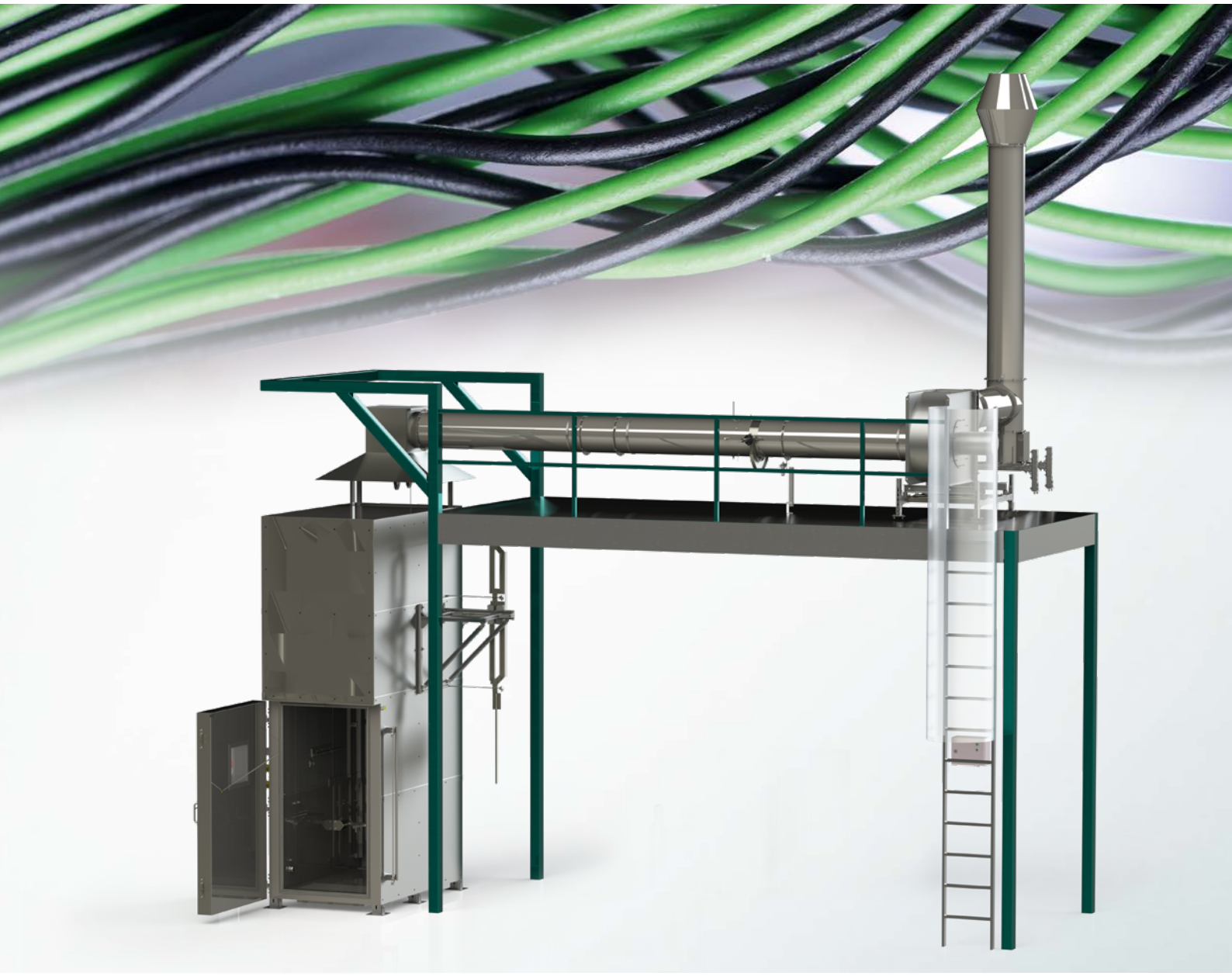
TAURUS INSTRUMENTS



Fire Testing System for Cables – KBT 916

Bunched Cable Vertical Flame Spread Tester
in Accordance with EN 50399 and IEC 60332-3-10

Analyzing & Testing

Bunched Cable Vertical Flame Spread Tester – KBT 916

For testing the vertical installation of a bunched power, control or fiber optic cable to suppress vertical spreading of the flame under specified conditions. Most important parameters, such as the heat release and smoke production during flame spread tests under fire condition are in accordance with EN 50399 and IEC 60332-3-10.

Fire tests are important for determining the behavior of cables in the case of fire. Single flame testing is the minimum performance requirement specified in the standards. The objective of these tests is to verify the flame spread characteristics of both the material and the cable construction.

The Construction Products Regulation (CPR) assigns a fire classification based on how well cables perform in fire tests in accordance with EN 50399, EN 60332-1-2, EN 61034-2 and EN 60754-2. Classifications are then made from A_{ca} (non-flammable) to F_{ca} (the lowest, no requirements).

Since cables are items that are critical to safety, quality and safety should be the main points of focus when specifying and selecting the right cable for an application.

Cables can be simple or complex, and even minor changes in design, material or manufacturing process can significantly affect their properties. They may even fail to function as expected, either in normal use or under extreme conditions, which can have a serious impact on their lifespan.

Such damage can have tragic consequences, as the fire in the Grenfell Tower in London, Great Britain, has shown in 2017.

Method & Required Cable Material

Test Method

In a chamber, the cable is exposed to a burning time of 20 min. The cables (number depending on the cable diameter) are mounted on a ladder in a vertical tube furnace and a flame is applied to them using a ribbon-type propane gas burner (AGF) with Venturi Mixer (20.5 kW/30 kW). The ignition point is adopted to evaluate the combustion behavior and combustion performance of the cable.

Measurement

During this time, the flame spread and the burning droplets/particles are observed. At the end of the test, the length of the fire damage is measured. The flue gases emitted during combustion are collected under a defined air flow and transferred into an exhaust air duct. There, the speed of the air flow, the O_2 and CO_2 content, the light absorption and the temperature are measured. From these data, the emitted fire effect and the smoke formation are calculated.

Cables

The cable lengths to be tested are evenly distributed on the test ladder. The total width for cables and spaces is approximately 30 cm. During the fire test, the ladder with the cable specimens (facing inward, away from the wall) are placed vertically against a wall in a combustion chamber. In front of the ladder, the burner is placed at a distance of 7.5 cm from the specimens.

Test chamber with burner and sample holder (ladder)

Information Obtained by Reaction to Fire under Controlled Conditions

- Heat Release Rate (HRR)
- Total Heat Release (THR)
- Flame Spread (FS)
- Flame Propagation Rate
- Fire Growth Rate Index (FIGRA)
- Smoke Production Rate (SPR)
- Total Smoke Production (TSP)
- Smoke Density
- Droplet Count
- Burning Growth Rate Index
- Gas Analysis of O_2, CO_2 (CO as option)

Cable Length in Accordance with EN 50399

Using the EN 50399 test, one can obtain early-stage combustion performance data for cable fires. The heat release rate test shows flame spread along the cable and the fire source's potential impact on adjacent areas. In the dangerous area where the fire smoke density is high, tests on visibility and smoke indicate the impact on personal safety.

In accordance with EN 50399, each cable sample length amounts to 3.5 m.

The calculation of the total heat release (THR) and total smoke production (TSP) is based on the equation given in the standard.

TRENDSETTING TECHNOLOGY

Conform to Standard

Test Chamber

The test chamber with the total dimensions of 135 x 235 x 430 cm^3 (WxDxH) consists of a double wall design with stainless steel cladding and square steel profiles. The insulation is made of a 6.5-cm-thick layer of mineral wool. For air supply, an opening in the ground is installed with a width of 80 cm and a depth of 40 cm. The air chamber has an extinguishing water drain. There is also an opening for smoke extraction (100 cm x 30 cm).

The sample holder (ladder) can be moved very easily via the rails and the electric winch at the rear wall. A ramp facilitates entry of the specimen from the doorstep to the test chamber.

Chamber Door

The door of the test chamber is made of stainless steel. The hinges and handles can be mounted on either the left or the right side. The incorporated window (40 x 40 cm^2) is double-glazed. The door dimensions are 216 cm in height and 134 cm in width.

Ribbon Burner

The ribbon propane burner comes with a Venturi mixer, igniter and flame detector.

A ribbon burner is quieter, more efficient, and longer-lasting than a traditional pipe-style burner. There is no steel in contact with forge temperatures, which means no scaling and degrading of burner components.

Two Flow Meters

The gas installation includes pressure regulators, mass flow controllers and solenoid valves for propane and compressed air as well as a shut-off valve for propane. It sits in a steel cabinet.

Measuring Tube and Sample Holder

The stainless steel measuring tube consists of a gas sampling probe, two guiding wings and a general measuring section. Differential pressure measurement is achieved by the bidirectional sonde (Venturi nozzle). The optical measuring section has a connection for compressed air for purging in order to prevent condensation effects. The sample holder is a welded tube construction made of stainless steel.

Measuring and Control Unit

The control unit is based on a Windows single board computer with a 10.1" color touch screen. The single board computer comes with 32 GB of SSD data storage, two USB connections, and one Ethernet connection. It is possible to measure temperature in the range from -100°C to 1300°C at a resolution of 0.1 K.

The control cabinet includes two mass flow controllers. Solenoid valves are included for calibration-gas, zero-gas (Nitrogen) and sample-gas (pump), calibration and zero gas as well as for the pump of the measuring gas device.

Light Measurement

The light measurement assembly is mounted into an aluminum case and includes a silicon photo receiver as well as tempered and heat-proofed optics. It comes with a spectral filter in order to simulate the CIE distribution and a measuring light amplifier The light transmitter has a halogen point source of 10 W and a color temperature of 2900 K. The beam diameter amounts to 25 mm (d / f = 0.0375).

Venturi Effect

The Venturi effect is the reduction in fluid pressure that results when a fluid flows through a constricted section (or choke) of a pipe.

Euro Classification

Trendsetting Technology

Euro Class	Standard	Main Classification	Smoke Development	
B1	EN 50399 (30 kW flame source)	▪ FS ≤ 1.75 m ▪ THR_{1200s} ≤ 10 MJ ▪ Peak-HRR ≤ 20 kW ▪ FIGRA ≤ 120 Ws^{-1}	s1	TSP_{1200s} ≤ 50 m^2 Peak-SPR ≤ 0.25 m^2/s
	EN 60332-1-2	▪ H ≤ 425 mm		
B2	EN 50399 (20.5 kW flame source)	▪ FS ≤ 1.5 m ▪ THR_{1200s} ≤ 15 MJ ▪ Peak-HRR ≤ 30 kW ▪ FIGRA ≤ 150 Ws^{-1}	s1a	compliance with s1 transmittance ≥ 80 %
	EN 60332-1-2	▪ H ≤ 425 mm		
C	EN 50399 (20.5 kW flame source)	▪ FS ≤ 2.0 m ▪ THR_{1200s} ≤ 30 MJ ▪ Peak-HRR ≤ 60 kW ▪ FIGRA ≤ 300 Ws^{-1}	s1b	compliance with s1 transmittance ≥ 60 % < 80 %
	EN 60332-1-2	▪ H ≤ 425 mm		
D	EN 50399 (20.5 kW flame source)	▪ THR_{1200s} ≤ 70 MJ ▪ Peak-HRR ≤ 400 kW ▪ FIGRA ≤ 1 300 Ws^{-1}	s2	TSP_{1200s} ≤ 400 m^2 Peak-SPR ≤ 1.5 m^2/s
	EN 60332-1-2	▪ H ≤ 425 mm		Products for which no performance is specified or which do not meet the criteria for s1 and s2
E	EN 60332-1-2	▪ H ≤ 425 mm		
F	no performance stipulated			

Gas Treatment

The flue gas is extracted via a pump (60 - 300 l/min) in the area of the measuring section and is initially filtered through a prefilter and a fine filter (0.1 µm). The sample gas is dried at 10°C by an efficient Peltier cooling system without mechanical components. Drying with a drying agent (Drierite) is additionally possible. The flow of the sample gas through the analyzer is controlled by means of bypass valves.

Gas Analyzer for Determination of the Thermal Power Values (HRR, SPR, etc.)

The use of optical couplers and optical filters in IR physics leads to an increase in selectivity. This ensures the ability to measure at low concentrations and low detection limits. To this end, the system is equipped with the robust Siemens ULTRAMAT/OXYMAT 6E, featuring corrosion-resistant materials in the gas channel. It serves for the detection of two infrared components, CO_2, and O_2 as well as CO (optional) in accordance with the standards.

Maximum security against fire

Basic security against fire

TEST CRITERIA & EURO CLASSIFI-CATION

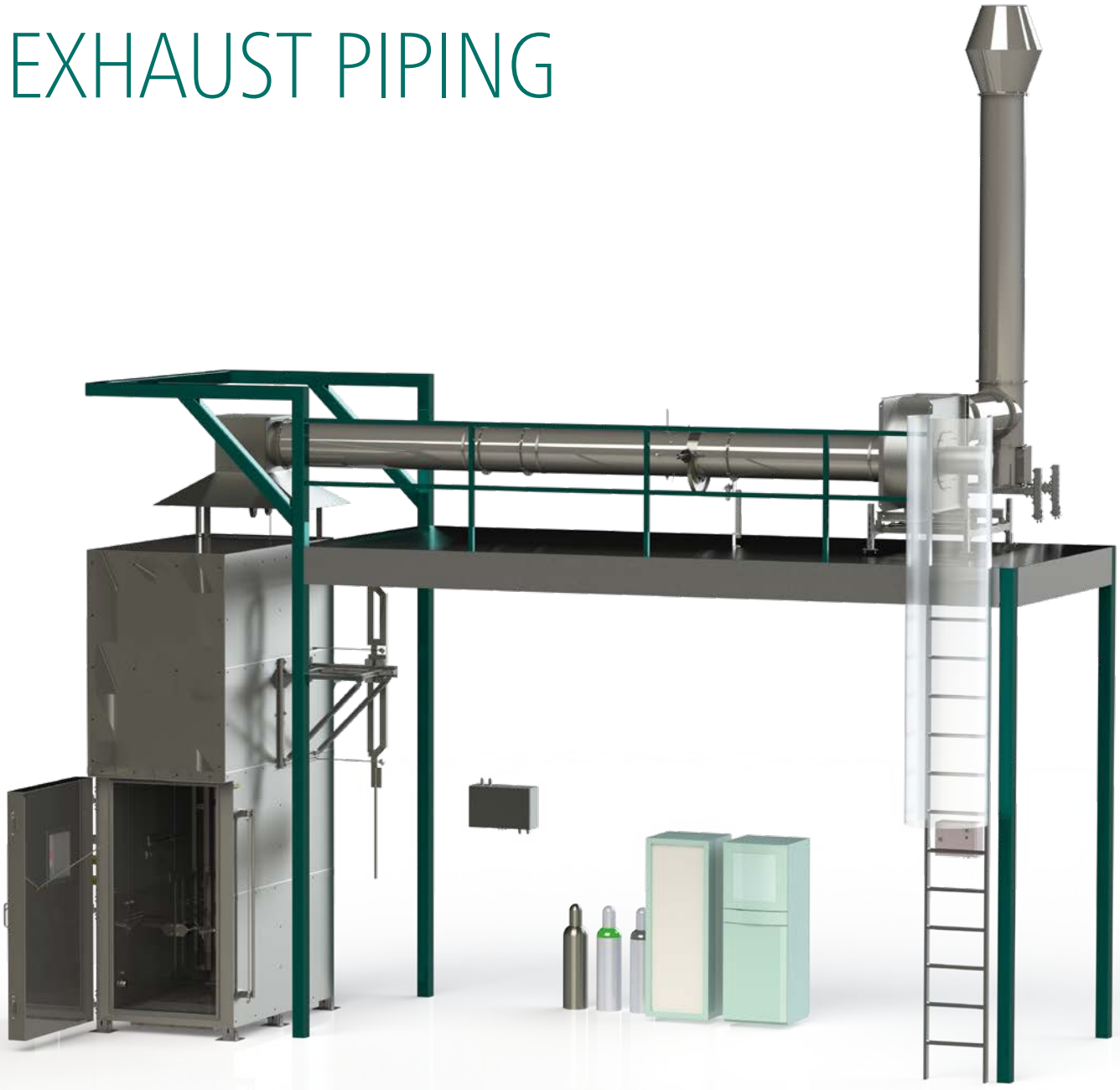
Flaming Droplets/ Particles Classification	Smoke Acidity Classification
d0 = if no flaming droplets/ particles occur within 1200s	a1 = if an electrical conductivity of < 2.5 µS/mm and a pH of > 4.3 are obtained during testing according to EN 50267-2-3
d1 = if no flaming droplets/ particles lasting for more than 10 s occurs within 1200 s	a2 = if an electrical conductivity of < 10 µS/mm and a pH of > 4.3 are obtained during testing according to EN 50267-2-3
d2 = if no performance is specified for the product or it does not meet the criteria for d0 and d1	a3 = if no performance is specified for the product or it does not meet the criteria for a1 and a2 according to EN 50267-2-3

- Total Heat Release (THR): The total heat release during the evaluation period, less the contribution of the ignition source in [MJ]
- Flame Spread (FS): The vertical flame propagation in [m], corresponds to the damaged length of the sample
- Peak-HRR (HRR): Maximum heat release value, less the contribution of the ignition source, determined throughout the burner application period, averaged above 30 s and expressed in [kW]
- Peak-SPR (SPR): Maximum smoke production value, determined throughout the burner application period, averaged above 60 s and given in [m^2/s]
- H: Distance from the upper starting point of the charring (above the flaming point) to the lower starting point of the charring (below the flaming point) in [mm], measured in accoranc with EN 60332-1-2
- Fire Growth Rate (FIGRA): The heat release rate index for classification purpose in [W/s]
- Total Smoke Production (TSP): The total smoke produced during the evaluation period in [m^2]
- Flaming droplets/particles: Material that detaches from the sample during the test and continues to burn for a minimum period (specified in the test procedure)

- Measuring method in accordance with DIN EN 50399
- KBT test chamber with sample holder, hood, collector, measuring tube, gas installation, burner, air supply and sensors
- Double-walled test chamber, stainless steel with mineral wool insulation, opening for air supply at the bottom, opening for smoke extraction, rail guides on the back wall for easy mounting of sample holders, electric winch assembly, stainless steel door with fireresistant glazing
- Cable winch with electric drive, ramp and option for easier transport of the sample holder
- Exhaust gas fan with frequency converter and digital flow control for constant exhaust gas flow
- Modules for data acquisition and control of all processes
- Extensive options and accessories for enhancing the exhaust system and for calibrating the KBT test unit
- Stainless steel extraction hood and collector for protection against aggressive gases
- Measuring duct section with bidirectional probe, NiCrNi thermocouples, light measurement system and gas sampling probe
- Ribbon propane burner with Venturi mixer, electric spark igniter, flame detector, folding mechanism and stainless steel protective cover
- Gas installation with digital gas flow controller, pressure controller and magnet valves
- Supply air process fan and digital control module
- "KBT Control" measuring and control unit with SBC, 32-GB SSD, Windows 10, 10.1" color touch screen, SIEMENS gas analyzer, measuring gas processing, measuring and control modules and RS232/USB interfaces
- 19" PC rack, monitor, printer, PC (option)
- Single license for the KBT software

Features at a Glance

SCHEMATIC DRAWING OF KBT 916 AND EXHAUST PIPING



Schematic drawing of the KBT 916, open measuring chamber with ladder dimensions of the entire device:
length 8.60 m x width 2.50 m x minimum height 4.10 m

KBT 916 SOFTWARE

Graphical and numerical display of all test results

- Freely configurable display of results (chart, diagram, text); up to 16 configurable windows

User guidance for test procedure and dialog for automated adjustment of gas analysis

- Prior to test, 300-s recording of data
- Automatic activation of valves and burner
- Monitoring of HRR and excess temperature in the exhaust duct
- Online calculation: HRR, THR, SPR, TSP, FIGRA
- Calculation and display of the measurement results

Configuration of measurement points

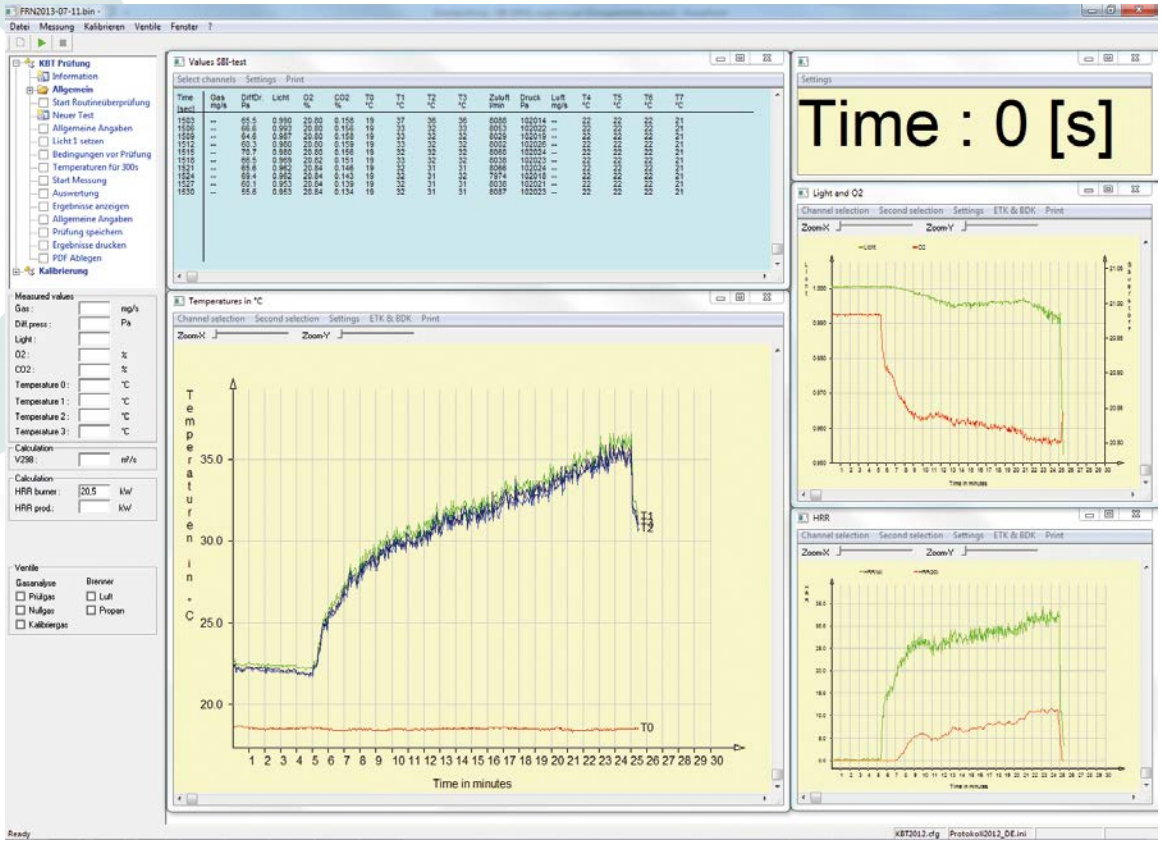
- Allocation of name, measurement range, correction value for each channel, analysis of thresholds

Calibration of gas analysis

- Automated adjustment and control of calibration gases via software

Calibration of test device in accordance with the standard (stability, step calibration test, heptan calibration, light)

- Easy calibration
- Analysis in an Excel file
- Calibration certificates for the individual sensors



Software for the KBT 916

Test report

- Test report printout in accordance with DIN EN 50399, with graphical and numerical display options
- Display of current calibration data as part of the test report
- Conversion to PDF format
- Copying of report data (texts/graphics) to the clipboard for further use in user-specific documents

Additional features

- Monitoring of measurement with display of relevant data and messages; shutdown when individual values exceed critical thresholds
- Storage of test data in raw format (binary) and storage in CSV format
- Acoustic signals

Firmware KBT2016_SBC

- Control of the hardware via embedded PC
- 10" high-resolution display
- Control of hardware components (e.g., valves, gas analyzer, light measurement system, pressure sensors and mass flow controller)
- Data logging for sensors
- Control of air inlet and outlet fan
- Monitoring of test with visual and acoustic signals

IN ACCORDANCE WITH STANDARDS

TEST REPORT

EASY CALIBRATION

CSV FORMAT

DIALOG WITH SOFTWARE

ONLINE CALCULATION

AUTOMATED GAS ADJUSTMENT

CONTROL OF HARDWARE COMPONENTS

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